



Saskatchewan
Environment
Hydrology Branch

Souris River Basin 1979 Spring Runoff

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SOURIS RIVER BASIN

1979 SPRING RUNOFF

HYD - 1 - 23

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January, 1984

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ACKNOWLEDGEMENTS

The gathering and compilation of hydrometric data contained in this report involves several agencies and many individuals. The services of Water Survey of Canada, Environment Canada, Conservation and Development Branch of Saskatchewan Agriculture, Saskatchewan Power Corporation, city and rural municipal officials, and private individuals throughout the basin are acknowledged and appreciated.

CHAPTER I

INTRODUCTION

A. THE SOURIS RIVER BASIN IN SASKATCHEWAN

From the headwater area near Cedoux the Souris River main stem runs in a northwesterly direction as shown on Figure 1. It turns south near Lewvan then southeast through Yellow Grass Marsh area. Natural drainage through and immediately below the marsh has been improved by construction of the Yellow Grass Ditch which joins the natural Souris River channel northwest of Weyburn. From the end of Yellow Grass Ditch the river runs in a general southeasterly direction for some 110 km to Roche Percee, past the two cities of Weyburn and Estevan. It then follows a more easterly direction to the community of Glen Ewen and finally follows a southerly course before crossing the international boundary into United States some 23 km south and 3 km east of the Village of Glen Ewen. International flow is measured at a hydrometric station located some 25 km west of Sherwood, North Dakota.

Downstream of Weyburn the depth of the river valley increases and there are a number of tributaries, large and small, which join the river in the 50 km distance from Weyburn to Dead Lake. Below Dead Lake the river has a low gradient and inundation of the flood plain is a frequent

occurrence in the reach between Dead Lake and Estevan. Long Creek, the largest western tributary, joins the Souris River near Estevan. With its headwaters area in the hills west and northwest of Radville, the stream receives most of its flow from the Saskatchewan portion of the drainage area. At the lower end it crosses the International Boundary and re-enters Saskatchewan some 15 km further east, a short distance south of Estevan. Boundary Dam, located on Long Creek just above the confluence with the Souris River, forms the largest and most important storage reservoir in the Saskatchewan portion of the Souris basin, with a storage capacity of 60 500 dam³ at full supply level.

East of Estevan the river is joined at Roche Percee by Short Creek and near Oxbow by Moose Mountain Creek, which is the largest northern tributary to main stem flow in Saskatchewan.

B. SCOPE OF REPORT

This report documents the 1979 spring runoff in the Souris River basin in Saskatchewan. It does not, however, cover runoff in tributaries that drain to the east such as Antler River and Gainsborough and Pipestone Creeks which cross the provincial boundary and join the Souris River in Manitoba.

CHAPTER II

GENERAL CONDITIONS PRIOR TO AND DURING SPRING RUNOFF

Record peak flows and volumes were experienced over much of the Souris River Basin during the 1979 spring runoff. Flood damage was reported in many areas, however, some areas escaped major damage only after taking extensive preventative measures.

The above normal 1978 summer and fall precipitation left the surface and subsurface storage over the basin well above normal. The summer was highlighted by a major July storm centered in the Ceylon-Radville area which dumped in excess of 75 mm over a 200 km² area in less than twelve hours.^{1/} Precipitation from November, 1978, to March, 1979, was 123 per cent of normal (See Figures 2 and 3). Table 1 shows the recorded and normal precipitation values for the months of June, 1978, through April, 1979, for the meteorological stations throughout the basin.

Snow surveys were conducted in the basin on March 1, March 15 and April 1. In comparison with the 1970 to 1978 average, the 1979 water equivalents were 140, 175 and 220 per cent of normal on each of the survey dates, respectively. The water equivalents from the April 1 snow survey and 1979 were well below the maximum recorded

^{1/} An Analysis Of Runoff In The Souris River Basin, 1978, January, 1979, HYD-1-22, by Operation Planning Division, Hydrology Branch, Saskatchewan Environment.

Table 1

SOURIS RIVER BASIN
PRECIPITATION SUMMARY JUNE, 1978 TO MAY, 1979
IN mm OF WATER

STATION	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY
CEYLON	78.7 143.3	50.8 112.3	54.9 41.0	38.4 94.9	18.0 10.0	13.7 22.4	15.7 23.8	16.0 12.8	15.0 28.2	18.0 8.0	32.0 39.6	43.9
WEYBURN	78.5 131.6	53.1 105.4	44.2 22.6	35.8 78.2	17.0 11.2	13.0 23.6	14.7 28.5	15.7 3.0	11.2 20.6	13.7 8.0	29.0 48.6	49.8
MIDDALE	83.6 63.2	57.7 69.6	59.4 55.7	34.0 72.6	20.1 6.5	17.5 29.6	16.8 15.3	16.8 6.0	17.5 28.3	17.3 21.9	26.2 56.5	45.2
ESTEVAN	79.0 117.9	61.7 54.1	50.8 65.5	35.3 87.3	23.6 11.3	19.6 30.0	19.8 19.7	19.6 9.2	16.5 22.4	17.8 18.7	30.5 61.8	47.0
OXBOW	81.0 88.4	57.9 53.1	58.2 49.0	27.7 60.9	21.6 3.4	22.4 20.0	16.8 6.0	16.8 6.0	18.5 40.0	18.0 34.0	26.4 16.0	37.3
CARLYLE	78.7 64.8	50.8 79.5	54.9 60.7	38.4 59.7	18.0 9.1	13.7 33.3	15.7 18.0	16.0 4.3	15.0 30.5	18.0 22.2	32.0 35.2	43.9
YELLOW GRASS	76.2 90.7	61.0 97.3	48.8 20.6	37.3 121.5	18.5 4.4	17.8 23.9	16.8 16.8	18.3 2.8	14.4 15.7	16.8 4.0	27.4 71.2	43.2
FRANCIS	78.0 61.5	63.2 39.4	53.8 25.1	33.3 45.2	17.3 7.4	15.0 36.8	14.2 6.4	16.8 3.3	12.4 11.7	12.4 33	24.4 44.3	38.9
ARCOLA	84.3 66.3	66.3 93.2	59.7 49.7	28.7 53.7	17.0 10.0	16.3 32.5	17.0 14.4	14.0 10.2	14.7 29.0	22.1 15.0	25.9 51.5	37.6
RADVILLE	75.9 116.8	42.7 127.8	60.7 21.8	34.0 98.6	16.5 11.4	14.7 40.6	19.3 40.6	25.1 20.3	21.1 53.3	19.8 26.7	26.2 66.0	47.5

Example:

NORMAL MONTHLY PRECIPITATION, mm OF WATER
(1941-1970)

Station A	78.7
	72.8

RECORDED MONTHLY PRECIPITATION, mm OF WATER

water equivalents from previous snow surveys done in the basin. Figure 4 shows the snow distribution as indicated by the April 1 survey.

In mid-March the snowpack was ripened somewhat by a period of above normal temperatures. Before any runoff took place, however, a period of cooler temperatures set in that lasted until mid-April. From April 10 to 13 more than 25 mm of water equivalent fell in the form of very wet snow over much of the basin (See Figure 5). Following this snow storm was a warming trend and by April 18 the runoff was under way. Snowmelt was so rapid that some of the tributaries crested within two days of the time they began to rise. By April 30, the crest on the main stem Souris River had passed out of the province after establishing new peak flow records at many of the hydrometric stations in the basin.

Generally the runoff was characterized by extremely high peaks in relation to volumes. When compared to the record event of 1976 the 1979 volumes were less but many of the peak flows were substantially higher. For example, in the Souris River at No. 47 Highway the 1979 volume was only 80 per cent of the 1976 volume while the peak flow was 135 per cent of the 1976 peak.

CHAPTER III

FORECASTING

Spring runoff forecasts issued by the Hydrology Branch, Saskatchewan Environment, prior to the 1979 runoff event are summarized in Table 2. All forecasts were based on recorded data up to the forecast date and a normal event to the end of the forecast period.

The late, extremely rapid melt acting on a fresh, well primed snowpack resulted in a great deal more runoff than predicted. Also worth noting is that the April 10 to 13 snowfall contained an unusually high water equivalent which, due to the type of melt, experienced virtually no losses prior to runoff and was responsible for a major portion of the runoff volume.

During the runoff period the Hydrology Branch updated streamflow forecasts daily. As the upstream flows materialized, more accurate projections of the flows downstream were made. These forecasts enabled downstream interests to prepare for the oncoming flows and were particularly useful in planning the operation of Boundary Reservoir.

Table 2

SOURIS RIVER BASIN
1979 SPRING RUNOFF FORECAST SUMMARY

Location	Forecasted												Recorded		
	February 1			March 1 and 15			April 1			April 15					
	Volume	Peak	Stage	Volume	Peak	Stage	Volume	Peak	Stage	Volume	Peak	Stage	Volume ²	Peak	Stage
Souris River at Weyburn	18 000	16	564.0	18 000	16	564.0	18 000	16	564.0	40 000	45	564.9		60	565.60
Souris River at Halbrite	23 000	20	550.4	23 000	20	550.4	23 000	20	550.4	50 000	55	552.2	122 000	115	553.15
Souris River at Estevan	100 000	75	536.7	100 000	75	536.7	90 000	75	536.7	140 000	125	537.6	339 000	251	538.05
Souris River at Roche Percee	110 000	85	529.1	110 000	85	529.1	100 000	85	529.1	150 000	130	529.9	368 000	243	530.32
Souris River at Oxbow ✓	140 000	90	507.3	140 000	90	507.3	120 000	90	507.3	200 000	140	507.6	450 000	240	508.60
Long Creek near Noonan	45 000	47		45 000	47	3.2	40 000	47	3.2	70 000	90	4.4	141 000	135	4.63
Hoose Mountain Creek near Oxbow	25 000	28		25 000	28	520.0	25 000	28	520.0	45 000	50	520.4	63 800	100	521.64

NOTE: Volume - dam³

Peak - cubic metres per second

Stage - metres

✓ Stage at Oxbow is MSC datum - correction to current PFRA datum = +4.438 m.

✓ March 1 to May 31

CHAPTER IV

FLOWS IN THE SOURIS RIVER BASIN

Hydrographs of the spring runoff event at the main hydrometric stations in the basin are shown on Figures 6 to 12, inclusive. Table 3 summarizes the peak flows and March to May volumes at key locations, along with comparable figures for the 1969 and 1976 spring runoff events.

A. UPPER SOURIS RIVER MAIN STEM

Runoff on the upper Souris River main stem started about April 18 and by April 21 the Souris River above Weyburn crested and began a normal recession. The quick melt caused severe ice jamming through the City of Weyburn and resulted in near record water levels.

Prior to runoff Weyburn Reservoir had been drawn down almost 1.5 m below full supply level (FSL). On April 20 the inflow to the reservoir began to exceed the outflow and by April 22 the reservoir level had crested 0.85 m above FSL.

Downstream of Weyburn, the Souris River crested at the Halbrite hydrometric station on April 23, with a mean daily flow of $118 \text{ m}^3/\text{s}$. This flow, together with extremely high local runoff, resulted in the highest levels ever recorded at the Dead Lake Project; maximum water levels occurred on

Table 3

SOURIS RIVER BASIN
SPRING RUNOFF VOLUMES, PEAK FLOWS AND PEAK STAGES

Stream	Station (at or near)	1979			1976			1969			Runoff Volumes March to May		
		Maximum Daily Flows			Maximum Daily Flows			Maximum Daily Flows			1/ Average Date of Peak Flow	Year	High Magnitude dam
		Rate (m ³ /s)	Stage or GH (m)	Date	Rate (m ³ /s)	Stage or GH (m)	Date	Rate (m ³ /s)	Stage or GH (m)	Date			
Gibson Creek	Radville	53	2.80	Apr. 18	25.7	2.18	Apr. 18	26.7	2.87	Apr. 4	1979	1976	18,000
Long Creek	Maxim	110	3.20	Apr. 21	64.8	2.86	Apr. 21	82.4	2.97	Apr. 10	1979	1976	59,500
	Western Crossing	130	580.61	Apr. 22	123	580.84	Apr. 22	99.7	580.80	Apr. 12	1979	1976	104,000
	Noonan	135	4.63	Apr. 19	162	5.33	Apr. 19	121	4.63	Apr. 11	1979	1976	144,000
	Below Boundary	108		Apr. 20	154	5.76	Apr. 20	113		Apr. 11	1979	1976	148,000
Yellow Grass	Yellow Grass	28	569.02	Apr. 26	51.5	570.16	Apr. 26	21.3	569.47	Apr. 13	1979	1976	99,500
Souris River	Below Lewvan	30	574.19	Apr. 23	95		Apr. 23			Apr. 10	1979	1976	61,000
	McTaggart	35	569.31	Apr. 22	50.1	569.54	Apr. 22	32.6	569.60	Apr. 10	1979	1976	108,000
	Above Weyburn	59	566.46	Apr. 21			Apr. 21			Apr. 13	1979	1976	122,000
	Highway No. 13	60	565.60 ^{2/}	Apr. 22	61.9	565.65	Apr. 22	68.0	565.84	Apr. 8	1979	1976	164,000
	Halbrit	115	553.15	Apr. 23	87.8	552.85	Apr. 23	62.9	17.15 ^{3/}	Apr. 12	1979	1976	244,000
	Dead Lake Project		541.98	Apr. 24		541.53	Apr. 24	104	538.65	Apr. 12	1979	1976	392,000
	Highway No. 18	177	538.75	Apr. 25	144	538.52	Apr. 25	206	538.13	Apr. 12	1979	1976	458,000
	Highway No. 47	251	538.05	Apr. 25	188	537.91	Apr. 25	203	6.80	Apr. 8	1979	1976	650,000
	Roche Percee	243	530.32 ^{4/}	Apr. 26	206	530.17	Apr. 26	238		Apr. 9	1979	1976	649,000
	Oxbow	240	508.60 ^{4/}	Apr. 28	385	509.23	Apr. 28	311		Apr. 7	1979	1976	152,000
	Glen Ewen	240	503.91	Apr. 29	388	504.08	Apr. 29			Mar. 31	1979	1976	44,500
	Sherwood									20,600	1979	1976	15,300
Moose Mountain Creek	Oxbow	100	521.64	Apr. 21	181	521.48	Apr. 21	113	521.63				
Short Creek	Roche Percee	35	4.0	Apr. 19	36.8	3.87	Apr. 19	39.9	3.98				
Jewel Creek	Goodwater	42	3.1	Apr. 22	26.9		Apr. 22	43.3					

1/ Average date for years in which the published peak falls within the three month spring period March to May inclusive.

2/ Maximum instantaneous = 565.81.

3/ 1969 record is water level on the lake side.

4/ Stage at Oxbow is WSC datum - correction to current PFRA datum = +4.438 m.

April 24. At the time of the peak, the dam separating the lake side from the river side of the project was under approximately 0.5 m of water.

In the headwaters of the Souris River, upstream of the Yellow Grass Marsh, the river peaked on April 22 with a mean daily flow of $22 \text{ m}^3/\text{s}$. This inflow built up water levels in Yellow Grass Marsh, after which outflow from the marsh storage began. The peak outflow from the Yellow Grass Marsh, as recorded at the "Yellow Grass Ditch near Yellow Grass" hydrometric station was approximately $28 \text{ m}^3/\text{s}$ on April 26.

B. LONG CREEK

Runoff in the Long Creek basin started with very small flows in the reach upstream of Boundary Reservoir in early April. Generally, however, the overall basin had no significant flow until April 18. Gibson Creek near Radville peaked at $40 \text{ m}^3/\text{s}$ on April 18 and Long Creek near Maxim crested at $112 \text{ m}^3/\text{s}$ (mean daily flow) on April 21; exceeding all previously recorded flows. Long Creek near Western Crossing experienced two peaks; the first on April 19 at $75 \text{ m}^3/\text{s}$, originating from local runoff, and the maximum mean daily flow of $118 \text{ m}^3/\text{s}$ ($125 \text{ m}^3/\text{s}$ instantaneous) on April 22, which originated in the upper basin, setting a new record for the station. Long Creek near Noonan also had two crests; the first and highest on April 19 at $132 \text{ m}^3/\text{s}$ was from local runoff and southern tributaries.

The second peak on April 23 at 128 m³/s was from the upper basin. Neither of these peaks exceeded the previously recorded maximum of 162 m³/s in 1976.

C. SOURIS RIVER AT ESTEVAN AND ROCHE PERCEE

In March, long before snowmelt occurred, the Souris River downstream of Long Creek was passing a small release from Boundary Reservoir. As intended, this flow cleared the channel of ice in the Estevan area and deteriorated the ice cover for a considerable distance downstream.

The first flow in the Souris River above Long Creek occurred on April 18 as a reverse flow resulting from the releases from Boundary Dam. This reverse flow resulted as Boundary Reservoir releases increased and continued until April 20 when upstream flows on the Souris River increased enough to overcome the backwater effect of Long Creek flows. Flows from the upstream Souris River continued to increase, reaching a record high level at Highway No. 18 on April 25, of 538.75 m, approximately 177 m³/s. At Highway No. 47, below the Long Creek confluence, the crest also occurred on April 25, and although the maximum stage was 0.08 m below the record stage set in 1969, the flow reached a record 251 m³/s, 22 per cent greater than in 1969. As the Souris River at No. 47 Highway was cresting, Boundary Reservoir was storing water with releases being approximately 30 per cent less than inflow to

the reservoir. To accomplish this Boundary Reservoir was surcharged by 0.30 m. Flows at No. 47 Highway receded steadily, however, it was early May before flows were again confined within the banks.

At Roche Percee Short Creek crested on April 19, at a near record flow of $42 \text{ m}^3/\text{s}$. By April 26, when the Souris River crested through Roche Percee at $243 \text{ m}^3/\text{s}$, Short Creek had receded to approximately $15 \text{ m}^3/\text{s}$.

D. LOWER SOURIS RIVER AND MOOSE MOUNTAIN CREEK

Although some local runoff began in the area as early as April 17, no significant flows occurred on Moose Mountain Creek until April 19. On April 21, the flows on Moose Mountain Creek near Oxbow crested at $100 \text{ m}^3/\text{s}$ under heavy ice flows.

On the main stem Souris River in the Oxbow area the ice remained intact until late on April 20. Until the ice moved out there was considerable concern in the Beaver Park area. Flows through the area first crested on April 21 at a flow of approximately $210 \text{ m}^3/\text{s}$ in response to the peak on Moose Mountain Creek. By April 28 when the upper main stem crest arrived, Moose Mountain Creek had receded to less than $25 \text{ m}^3/\text{s}$. The peak flow through the Beaver Park area near Oxbow

was approximately $240 \text{ m}^3/\text{s}$ which reached a stage of 508.6 m, about 0.6 m below the record high set in 1976.

Downstream, at the Souris River near Glen Ewen hydrometric station, the peak flows, similar in magnitude to those in the Oxbow area, occurred on April 22 and 29. From the crest the river receded normally and at the end of May a flow of approximately $25 \text{ m}^3/\text{s}$ was passing the international boundary downstream of Glen Ewen.

CHAPTER V

BOUNDARY RESERVOIR

In March, a release from Boundary Reservoir was started in an effort to provide storage for flood control as well as to remove ice in the channel downstream. By mid-April there was 16 000 dam³ of storage available in Boundary Reservoir.

As Long Creek flows materialized, Boundary releases were increased in order to pass as much water as possible before the upper Souris River flows arrived in the Highway No. 47 area. Outflows were gradually increased from 12 m³/s to 108 m³/s during April 18 to 22, and held at that level until the upper Souris River flows began to arrive in the area and then reduced while the Souris River flows passed. These operations succeeded in reducing the natural peak flow for Long Creek near Estevan by almost 20 per cent and for the Souris River below Long Creek by almost 10 per cent. (See Figure 9).

CHAPTER VI

FLOOD DAMAGE

During the 1979 spring runoff the Souris River was at a flood stage at many points along its length in Saskatchewan. As in past years there were four main areas of concern: Weyburn, River Park area near Estevan, Roche Percee, and Beaver Park area near Oxbow.

The City of Weyburn was, as in past floods, effective in surveillance and flood protection during the critical period. There were, however, some homes and commercial property located close to the river, in the flood plain which could not be protected from flooding at high water levels.

There were several homes in the River Park area near Estevan affected by overbank flooding although in most of these cases the basements would have been voluntarily filled with water to equalize the pressure even if no overbank flooding had occurred. The maximum stage at Highway No. 47 was only approximately 0.08 m below the record maximum level set in 1969 while at Highway No. 18 it was approximately 0.1 m above that recorded in 1969. Some of the homeowners had only access problems, and some were able to avoid or at least minimize flooding by constructing dykes.

In the Village of Roche Percee a successful dyking endeavour held back floodwaters in the order of 1.5 m above full bank levels.

Only minimal flooding problems were experienced in the community. At least one house did, however, experience flooding. In many of the other homes basements were filled with water to equalize pressure.

River flows at the Beaver Park area near Oxbow rose to a maximum of approximately 0.1 m above full channel levels. This inundated much of the area surrounding the homes located there and the water actually reached the foundation level on at least one home.

A general overview of the basin reveals that some flooding was experienced in rural areas. Several farm homes located in the flood plain reported damage and access was a problem to many farming operations and other interests along the valley.

FIGURES

HYDROMETRIC STATION NETWORK

<u>MAINSTEM SOURIS RIVER</u>	<u>STATION NO.</u>
SOURIS RIVER NEAR LEVON	5NB-25
YELLOW GRASS DITCH NEAR YELLOW GRASS	5NB-11
YELLOW GRASS DITCH NEAR E. TAGGART	5NB-30
SOURIS RIVER ABOVE WEYBURN	24-124
SOURIS RIVER NEAR WEYBURN (HWY. No. 17)	24-104
WEYBURN RESERVOIR NEAR WEYBURN	5NB-20
SOURIS RIVER NEAR HALBRITE	5NB-17
DEAD LAKE NEAR MIDALE	5NB-22
SOURIS RIVER AT HWY. No. 18 (NEAR ESTEVAN)	24-131
SOURIS RIVER AT HWY. No. 47 (NEAR ESTEVAN)	24-132
SOURIS RIVER AT ROCHE PERCEE	5NB-9
SOURIS RIVER NEAR GLEN EWE	5ND-1
SOURIS RIVER NEAR SHERWOOD	5ND-7
SOURIS RIVER NEAR OXBOW	24-133

LONG CREEK

GIBSON CREEK NEAR RADVILLE	5NA-5
LARSON DAM NEAR RADVILLE	5NA-6
LONG CREEK NEAR MAXIM	5NA-4
LONG CREEK AT WESTERN CROSSING	5NA-3
LONG CREEK NEAR NOONAN	5NB-27
LONG CREEK NEAR ESTEVAN	5NB-3
BOUNDARY RESERVOIR NEAR ESTEVAN	5NB-12

MOOSE MOUNTAIN CREEK

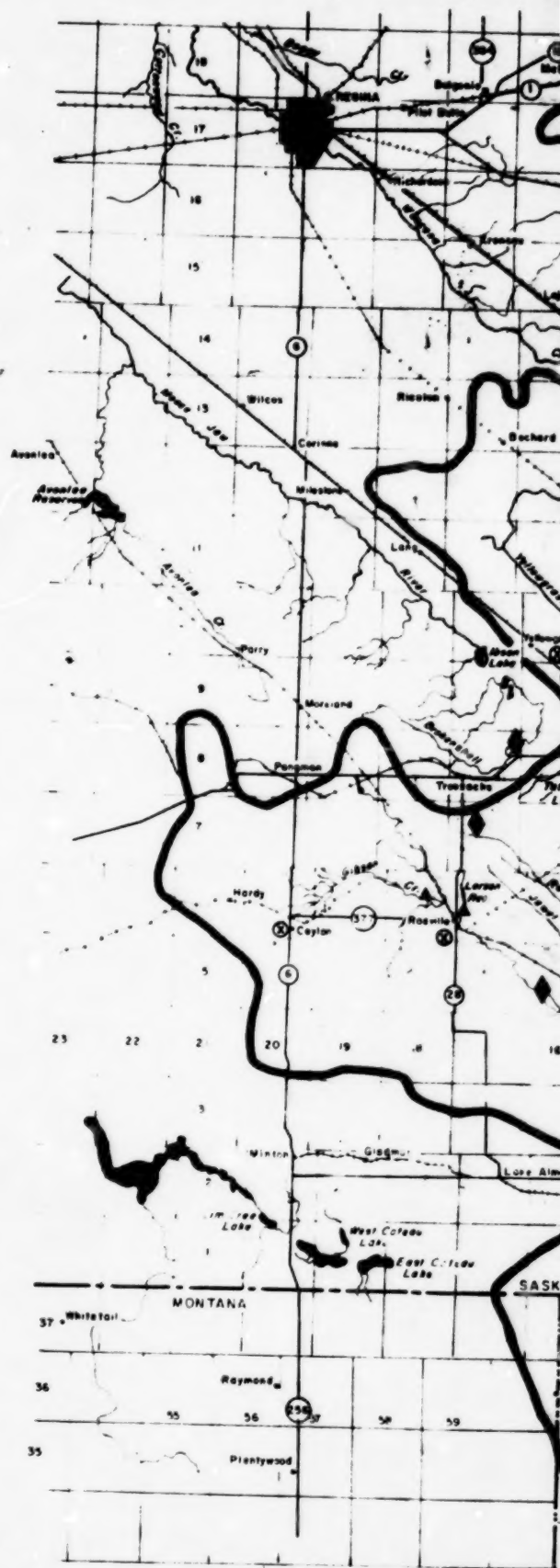
MOOSE MOUNTAIN LAKE NEAR CORNING	5NC-2
MOOSE MTN. CREEK BELOW MOOSE MTN. LAKE	5NC-1
MOOSE MOUNTAIN CREEK NEAR CARYLE	24-125
MOOSE MOUNTAIN CREEK NEAR OXBOW	5ND-4

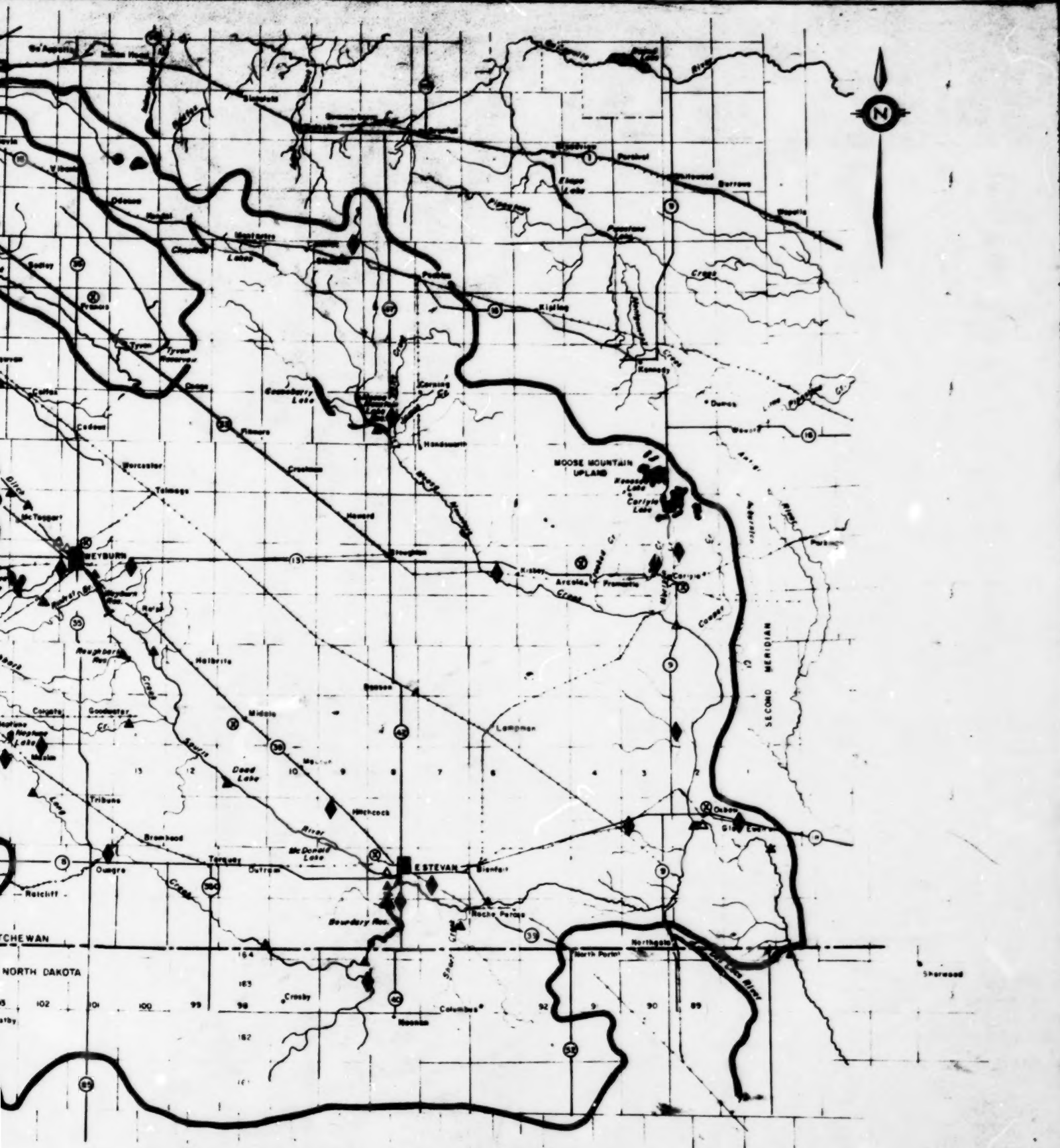
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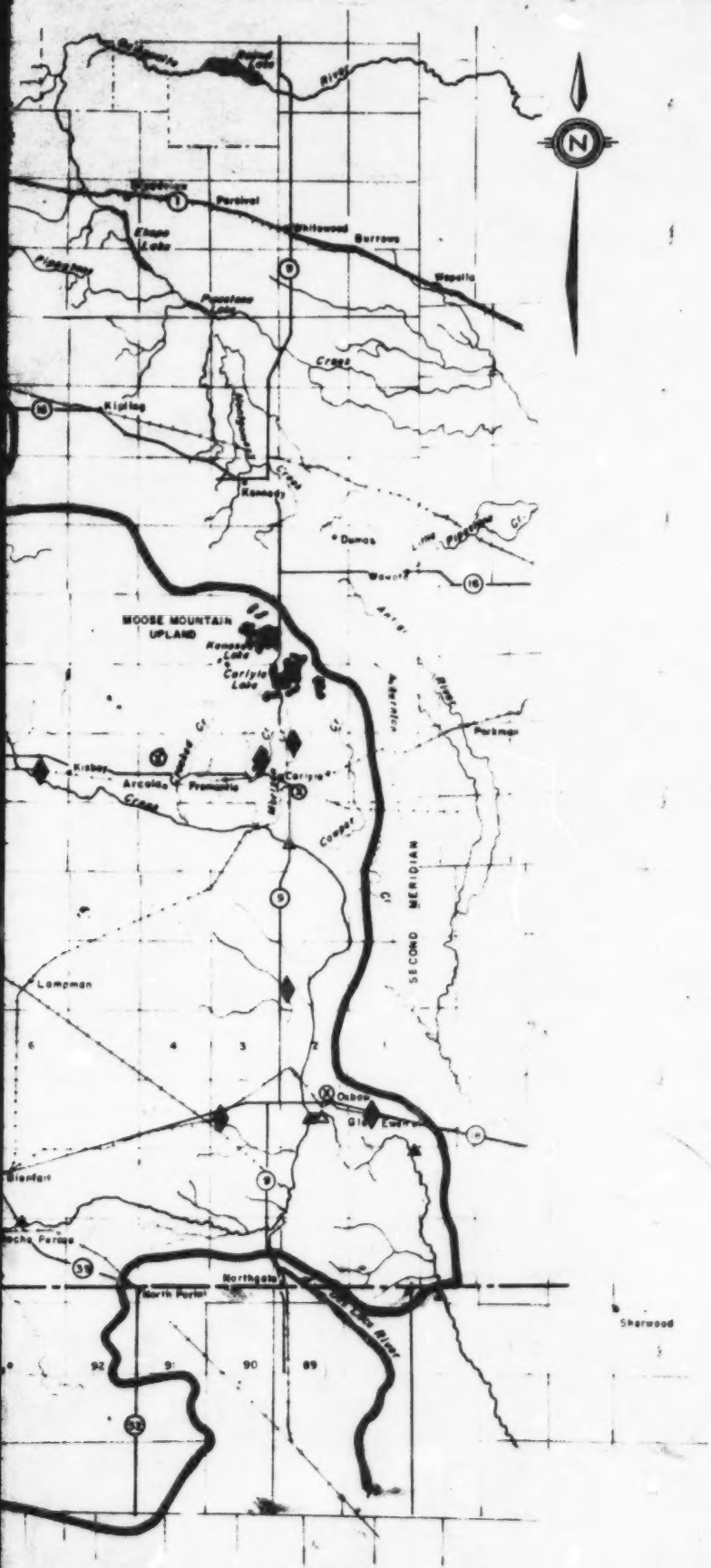
TATAGWA LAKE DRAIN NEAR WEYBURN	5NB-18
ROUGH BARK RES. NEAR WEYBURN	5NB-16
JEWEL CR. NEAR GOODWATER	5NB-14
SHORT CREEK NEAR ROCHE PERCEE	5NB-21

METEOROLOGICAL STATION NETWORK

<u>STATION</u>	<u>LOCATION</u>
CEYLON	Tp. 6 Rge. 20 W. 2
WEYBURN	Tp. 8 Rge. 14 W. 2
MIDALE	Tp. 5 Rge. 11 W. 2
ESTEVAN	Tp. 2 Rge. 8 W. 2
CARYLE	Tp. 8 Rge. 3 W. 2
OXBOW	Tp. 3 Rge. 2 W. 2
YELLOW GRASS	Tp. 10 Rge. 16 W. 2
RADVILLE	
FRANCIS	
ARCOLA	

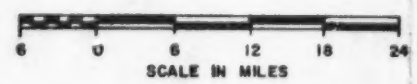






LEGEND

- GROSS DRAINAGE AREA BOUNDARY
- FEDERAL HYDROMETRIC STATION
- PROV. HYDROMETRIC STATION
- METEOROLOGICAL STATION
- SNOW COURSE

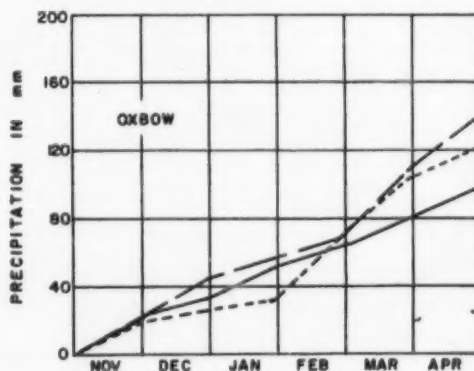
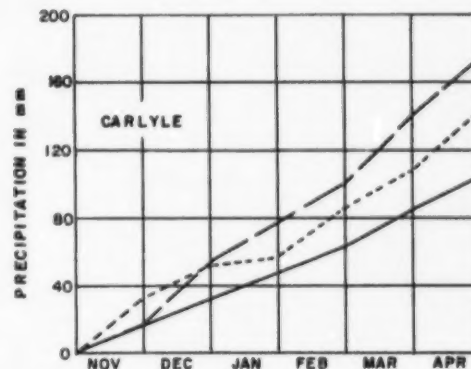
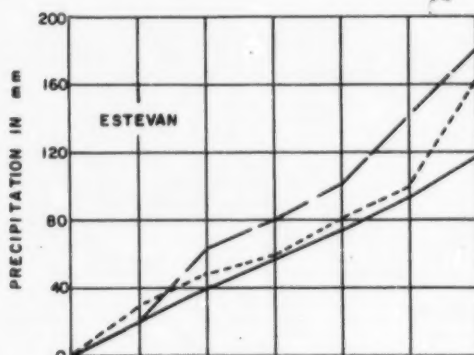
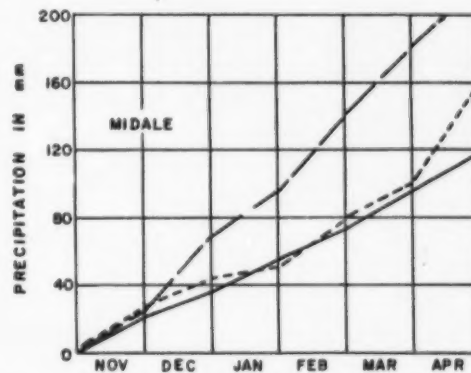
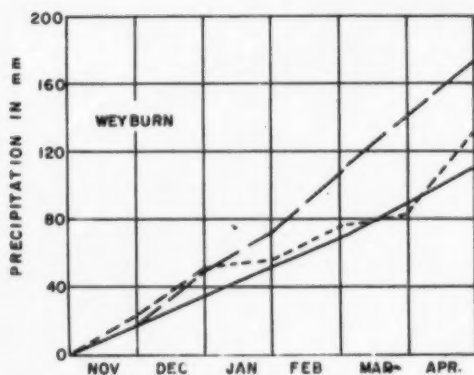
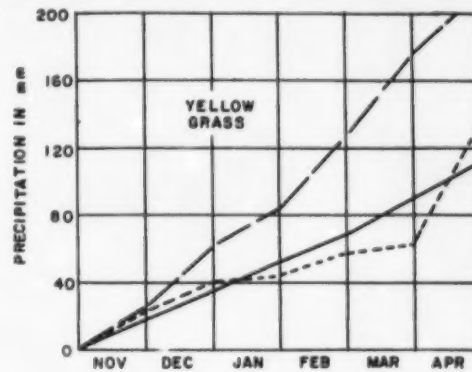
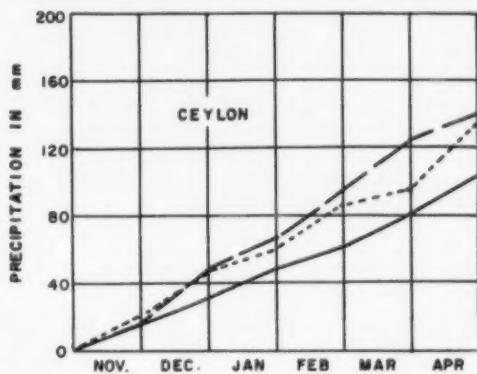


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SOURIS RIVER BASIN
1979 SPRING RUNOFF
KEY MAP

SHOWING
MONITORING LOCATIONS

Drm	Date JUNE/79	Figure 1
Ckd.	Plan No H-1(134)	



LEGEND

- 30 YEAR NORMAL
- 1975 - 1976
- . - . - 1978 - 1979

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Hydrology Branch

Drn

Date: JUNE/79

Ckd.

Plan No. HI-1 (135)

SOURIS RIVER BASIN
1979 SPRING RUNOFF

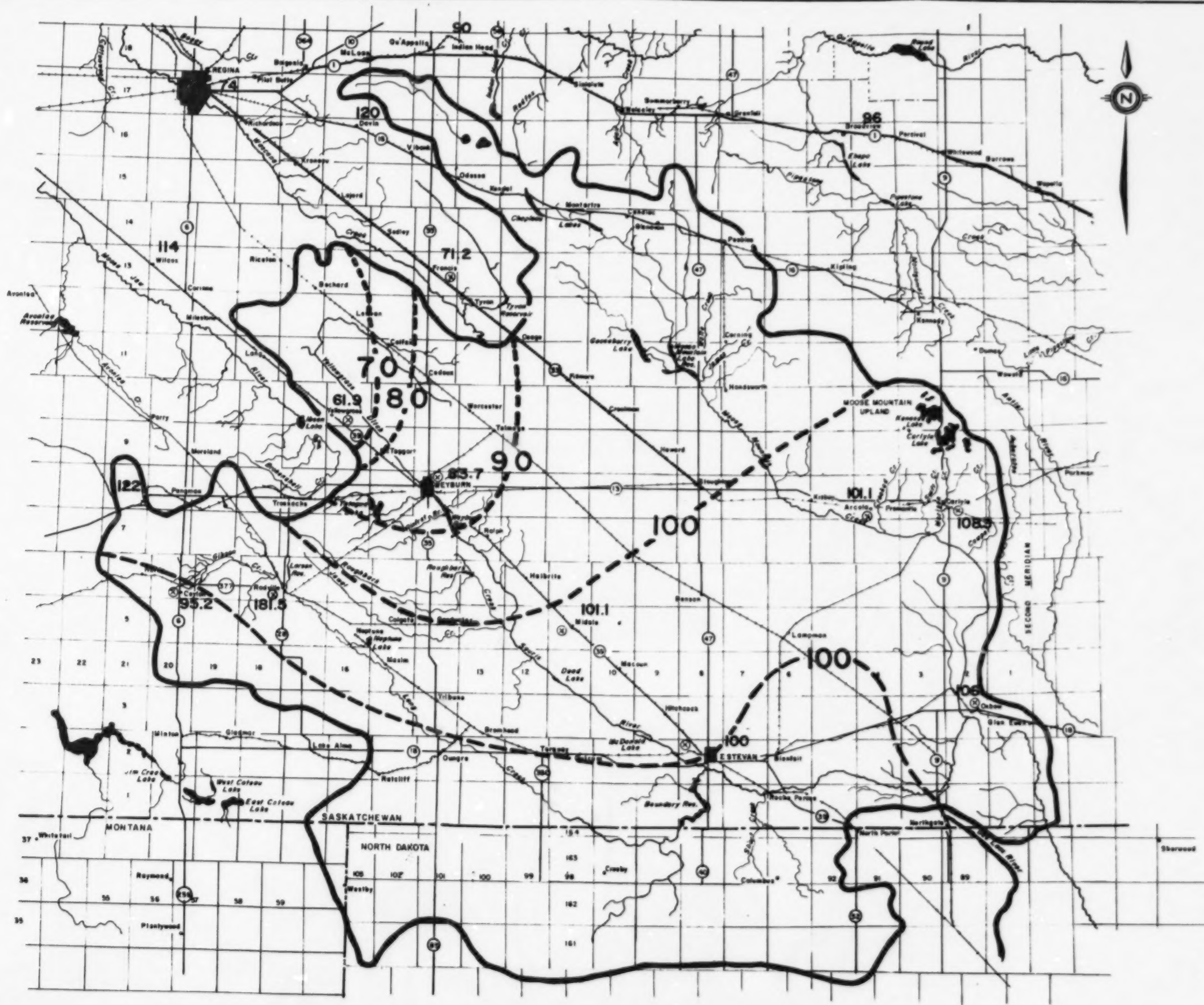
MASS CURVES

OF

WINTER AND SPRING PRECIPITATION

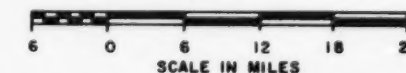
Figure

2



LEGEND

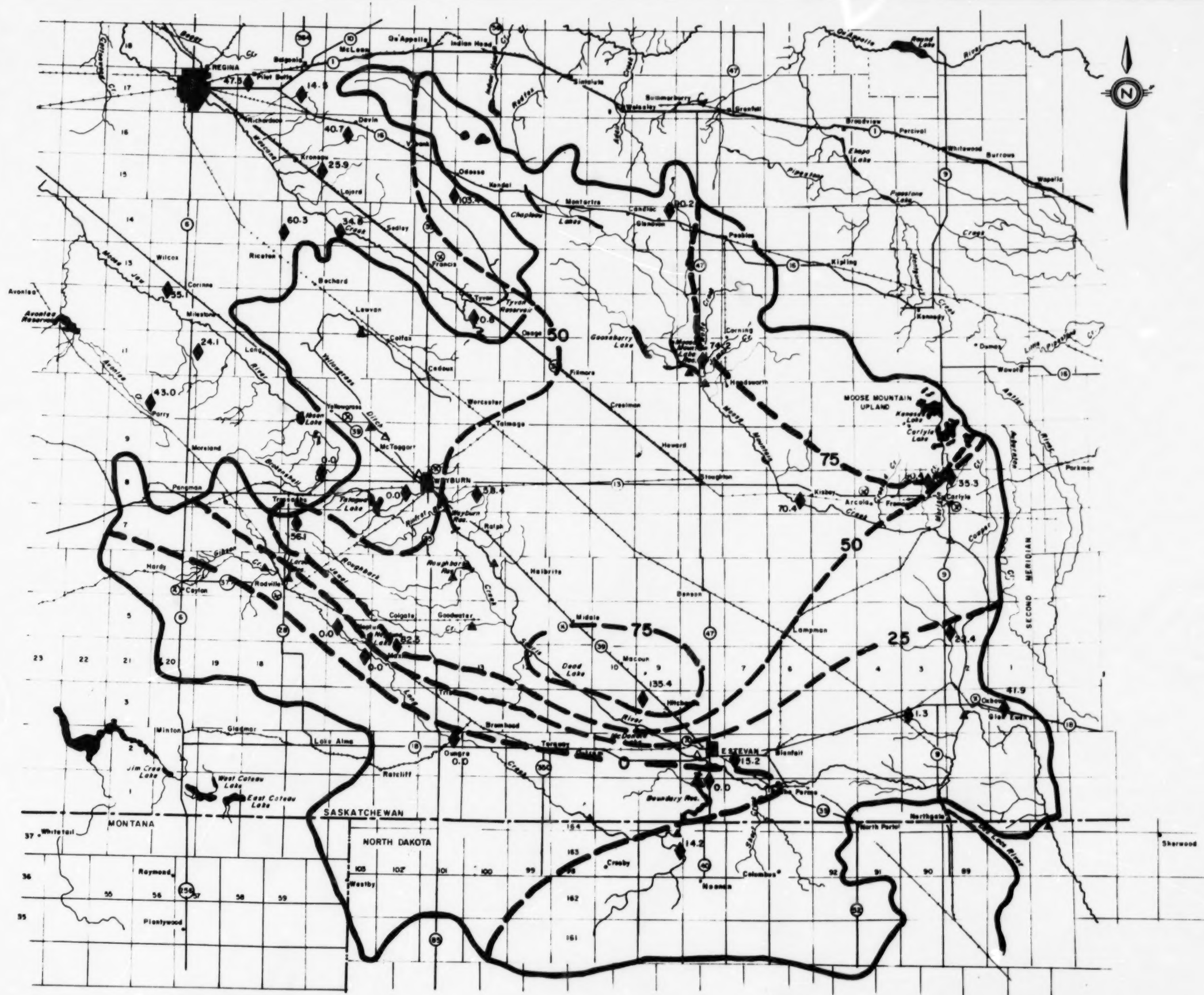
- GROSS DRAINAGE AREA BOUNDARY
- METEOROLOGICAL STATION
 (Number represents precipitation in millimetres of water equivalent)
- 70-- LINES OF EQUAL PRECIPITATION
 (Water equivalent in mm)



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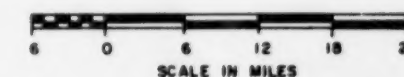
SOURIS RIVER BASIN
1979 SPRING RUNOFF
NOV. 1, 1978 TO MAR. 31, 1979
PRECIPITATION

Drn.	Date: JUNE/79	Figure 3
Ch'd.	Plan No. HI-1(136)	



LEGEND

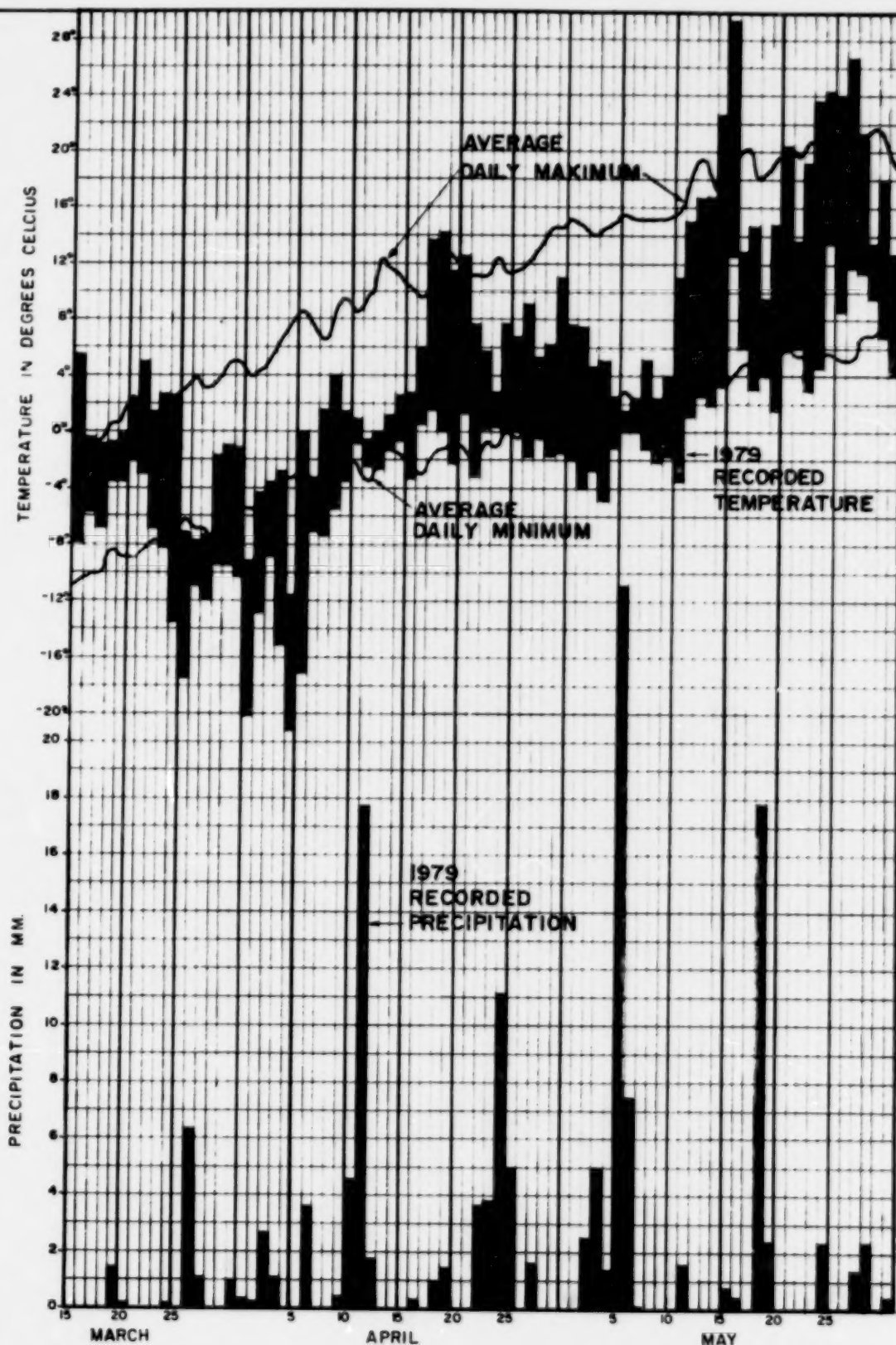
- GROSS DRAINAGE AREA BOUNDARY
- ▲ — FEDERAL HYDROMETRIC STATION
- △ — PROV. HYDROMETRIC STATION
- ⊗ — METEOROLOGICAL STATION
- ◆ — SNOW COURSE MEASUREMENT
(NUMBER REPRESENTS THE AVERAGE
WATER EQUIVALENT IN MILLIMETERS)
- - 25 - - LINES OF EQUAL WATER EQUIVALENT



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SOURIS RIVER BASIN
1979 SPRING RUNOFF
SNOW DISTRIBUTION
AS OF
APRIL 1, 1979

Drn	Date JUNE/79	Figure 4
Ckd.	Plan No. HI-1(137)	



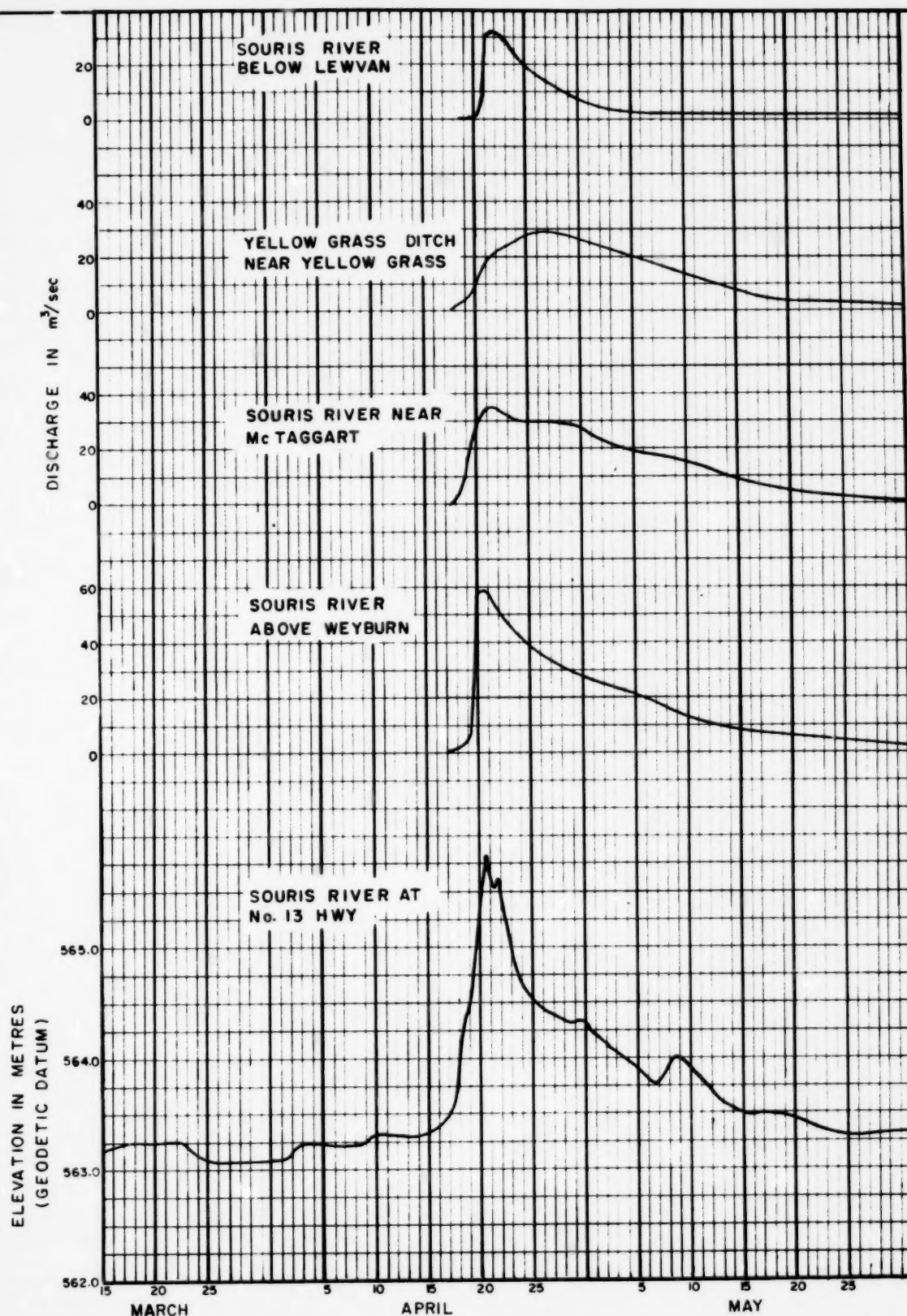
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Drn.	Date JUNE/79
Ck'd.	Plan No. HI-1(138)

SOURIS RIVER BASIN
1979 SPRING RUNOFF
COMPARATIVE SPRING TEMPERATURES
AND PRECIPITATION
AT
ESTEVAN

Figure

5



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Date JUNE /79

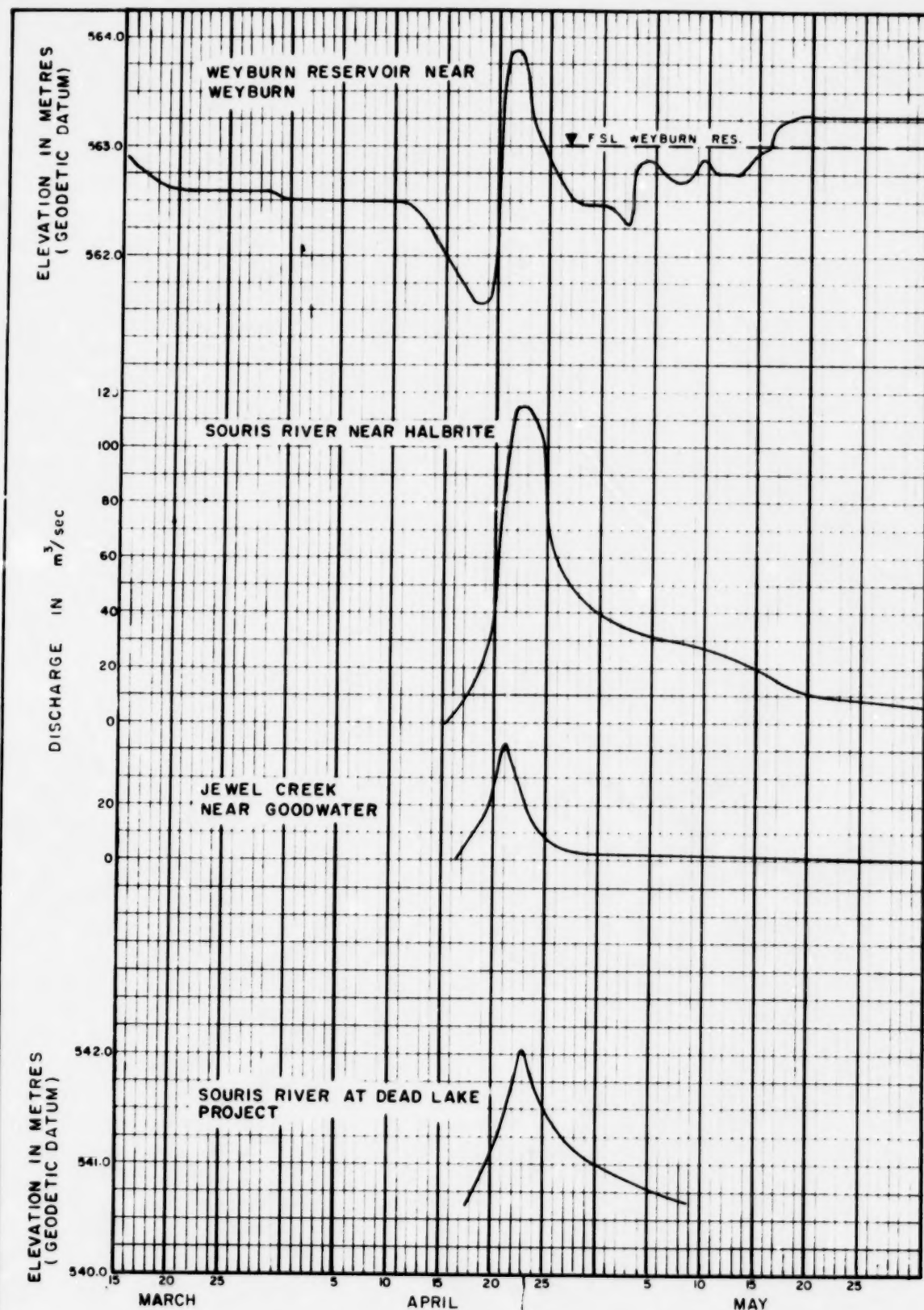
Ck'd.

Plan No. HI-1 (139)

SOURIS RIVER BASIN
1979 SPRING RUNOFF
1979 SPRING RUNOFF HYDROGRAPHS
UPPER SOURIS RIVER

Figure

6



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Date JUNE /79

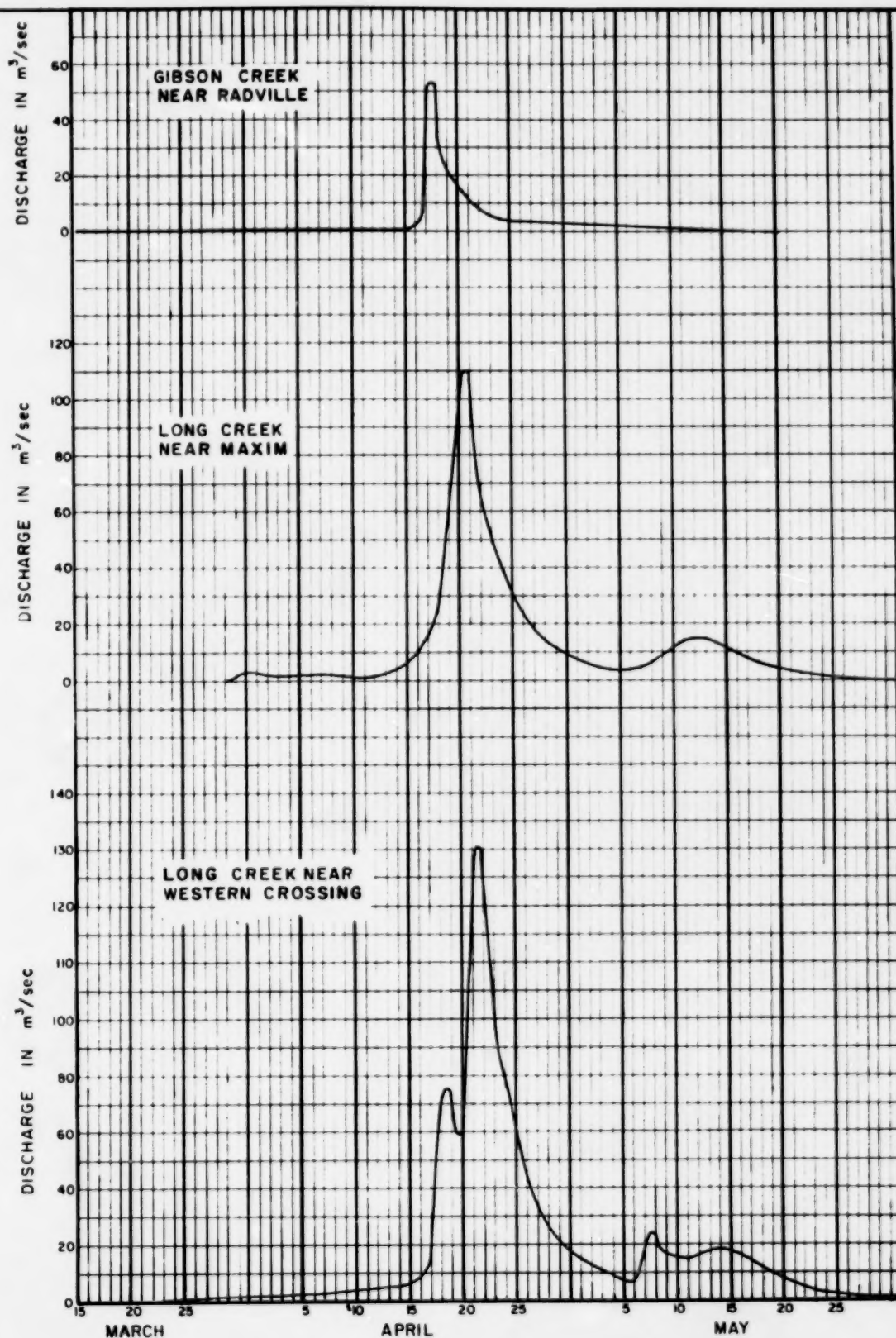
Ck'd.

Plan No. HI-1(140)

SOURIS RIVER BASIN
1979 SPRING RUNOFF
1979 SPRING RUNOFF HYDROGRAPHS
WEYBURN AND DEAD LAKE AREA

Figure

7



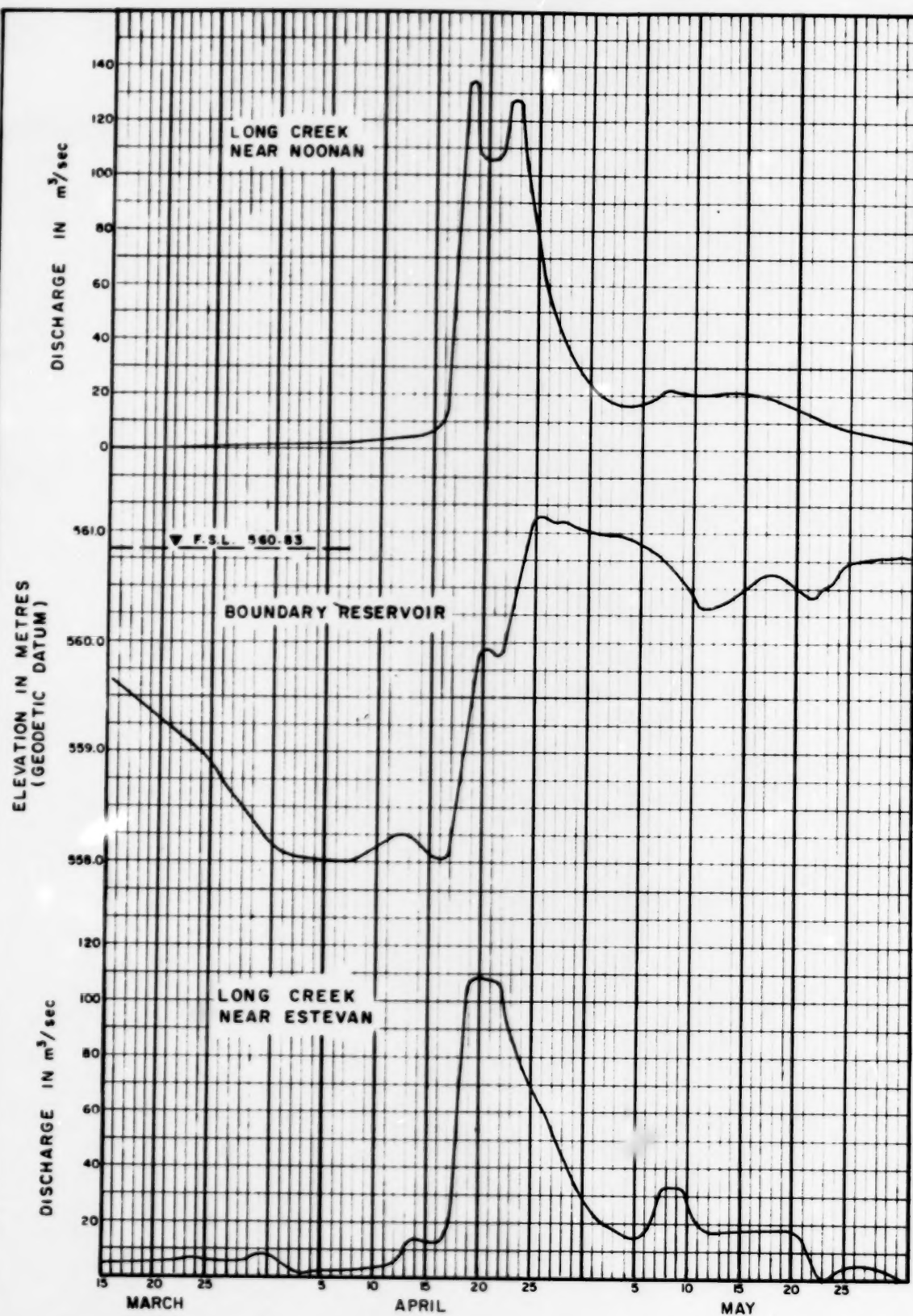
Saskatchewan Environment
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SOURIS RIVER BASIN
1979 SPRING RUNOFF
1979 SPRING RUNOFF HYDROGRAPHS
UPPER LONG CREEK

Figure

8

Drn.	Date JUNE /79
Ck'd.	Plan No. HI-1 (141)



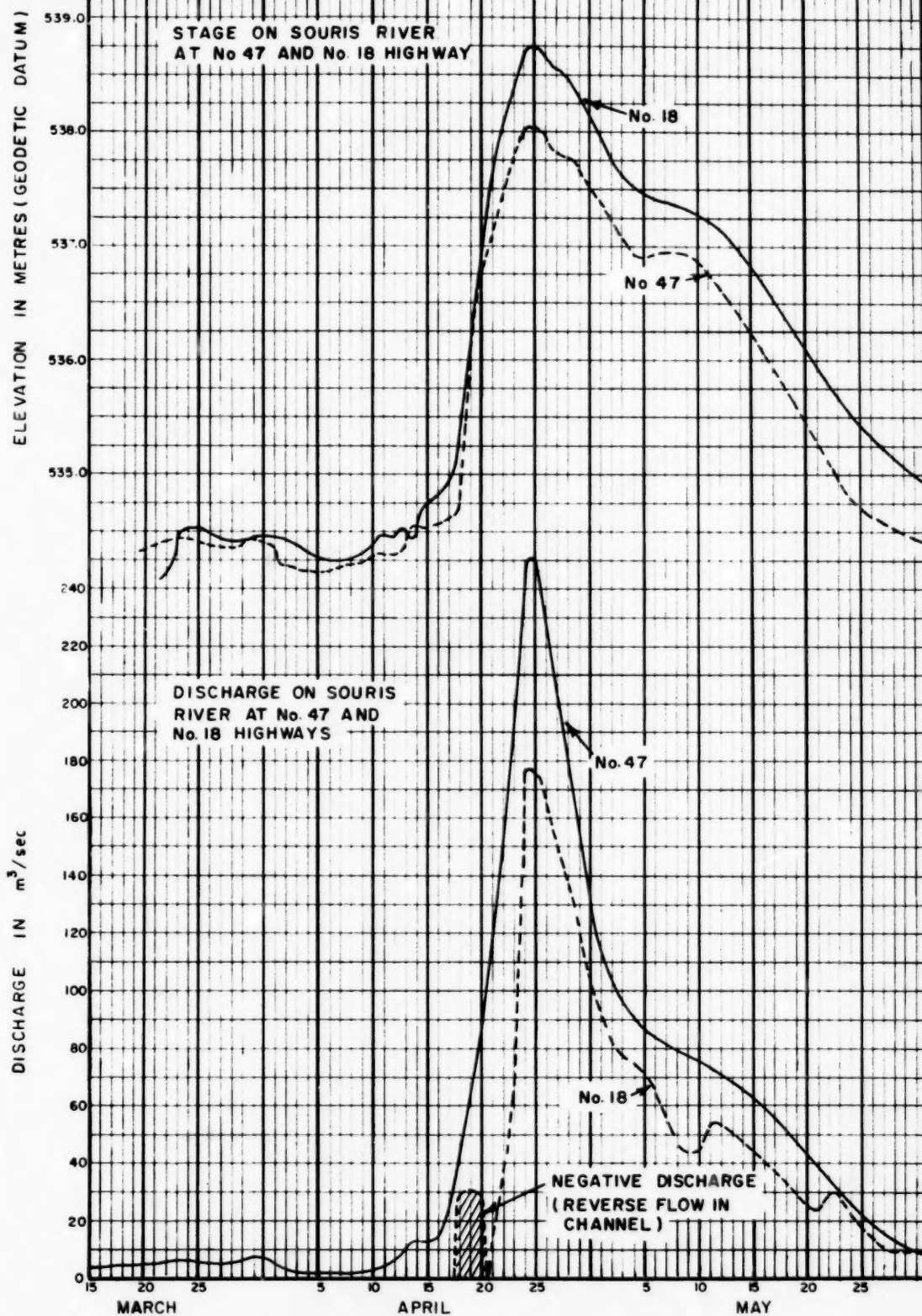
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Drn. _____ Date JUNE /79
Ch'd. _____ Plan No. HI-1 (142)

SOURIS RIVER BASIN
1979 SPRING RUNOFF
1979 SPRING RUNOFF HYDROGRAPHS
LOWER LONG CREEK

Figure

9



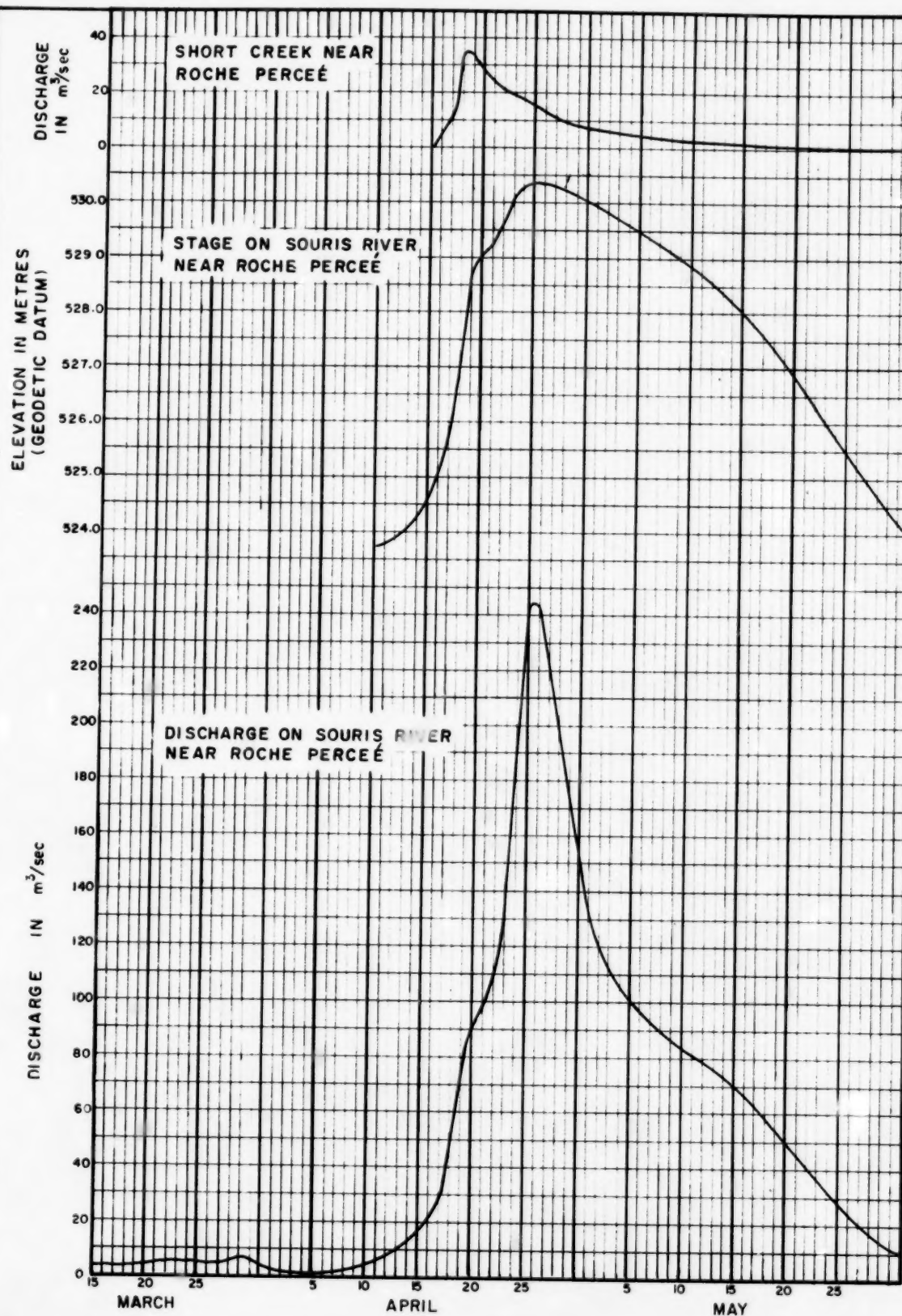
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Hydrology Branch

Drn.	Date JUNE/79
Ck'd.	Plan No. HI-1(143)

SOURIS RIVER BASIN
1979 SPRING RUNOFF
1979 SPRING RUNOFF HYDROGRAPHS
ESTEVAN AREA

Figure

10



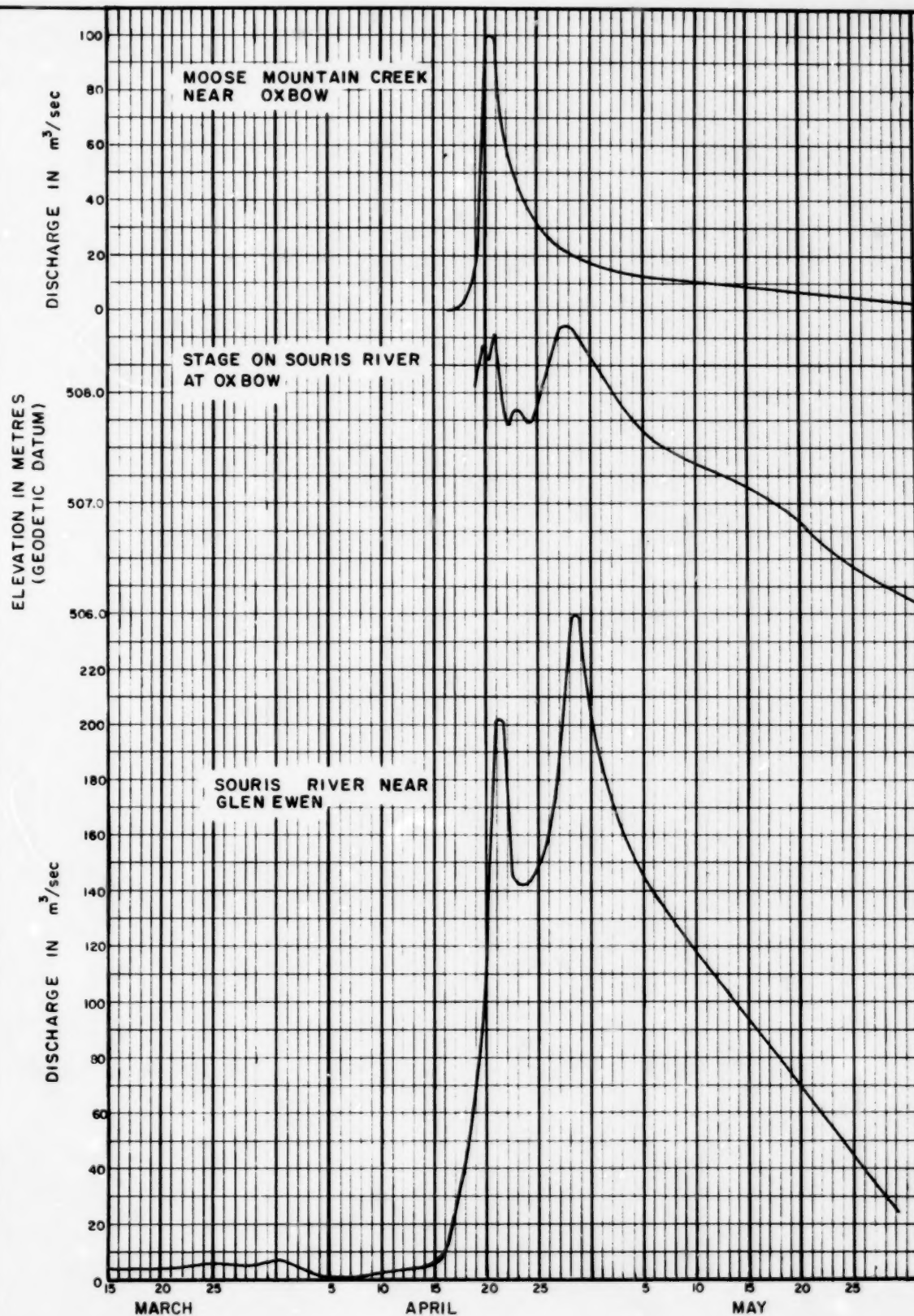
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Drn.	Date JUNE /79
Ck'd.	Plan No. HI-1 (144)

SOURIS RIVER BASIN
1979 SPRING RUNOFF
1979 SPRING RUNOFF, HYDROGRAPHS
ROCHE PERCÉE AREA

Figure

11



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SOURIS RIVER BASIN
1979 SPRING RUNOFF
1979 SPRING RUNOFF HYDROGRAPHS
LOWER SOURIS RIVER

Figure

12

Drn.	Date JUNE / 79
Ck'd.	Plan No. HI-1 (145)

POOR

QUALITY

ORIGINAL

